

| | |
|-------------|---|
| Title | Learning Process in Large System (制御過程論研究会報告集 I) |
| Author(s) | KITAGAWA, TOSIO |
| Citation | 数理解析研究所講究録 (1970), 99: 102-106 |
| Issue Date | 1970-10 |
| URL | http://hdl.handle.net/2433/108214 |
| Right | |
| Type | Departmental Bulletin Paper |
| Textversion | publisher |

Learning Process in Large System

Tosio Kitagawa
Kyushu University

1. The object of the paper is to give an approach which may provide with a general formulation of learning processes in large system. The standpoint of the author in this approach is based upon a logical consideration having been given by the author in the Dubrovnik Seminar on Large System in Biomathematical Sciences in 1968, August, and partly illustrated by him in his Japanese monograph [9] published in 1969 and also in his recent paper [12] in 1970.

2. Three Coordinations, Ist ; IInd and IIIrd ones, are introduced in the literatures [9] and [12] due to the author. The summary is given in Table 1.

The 1st Coordination consists of three principal coordinate axes : (a) objectivity, which contains three aspects (a_1), (a_2) and (a_3) ; (b) subjectivity, which contains (b_1), (b_2) and (b_3) ; (c) practice, which contains (c_1), (c_2) and (c_3).

Similarly for the IInd Coordination consisting of three principal coordinate axes. Now the IIIrd Coordination consists of three subspaces (\mathcal{O}) Control, (\mathcal{L}) eizon and (\mathcal{C}) creation. Each of these three subspaces has the six aspects to be gathered from the Ist and IInd Coordinations, along the first, the second and

Table 1. Three Coordinations I, II and III

| III I and II | III | III | III |
|-----------------|-------------------------|----------------------------|-------------------------------|
| | (α) control | (β) eizon | (γ) creation |
| I | (a) objectivity | (α_2) chaos | (α_3) transformation |
| | (b) subjectivity | (β_2) adaptation | (β_3) strategy |
| | (c) practice | (γ_2) stability | (γ_3) learning |
| II | (α) cognition | (α_2) induction | (α_3) abduction |
| | (β) direction | (β_2) eizon | (β_3) creation |
| | (γ) evaluation | (γ_2) reliability | (γ_3) plasticity |

the third columns respectively. In particular the new Japanese terminology "eizon" coined by the author comes from the combination of "ei" meaning management and "zon" meaning existence.

3. It is the opinion of the author that it is indispensable to take into our consideration all of these 18 fundamental aspects given in Table 1, in order to describe all the essential features of learning processes in large system.

An illustration of various formulations of control processes is given with reference to our three Coordinations.

This illustration includes our discussions and comments upon some of current theories of control processes which we owe to various authors such as Bellman [1], Box [2], Pontrajagin [16], Robbins-Monro [17] and Wiener [18] and the previous contributions due to the author himself [3]-[12], and the illustration may be said to be suggestive how far these formulations for evaluating can be expected to be useful for discussing large systems and for seeking for uncultivated areas which may be estimated to be important in discussing large systems.

4. In contrast with small systems, it seems to us to be indispensable to emphasise III (\mathcal{O}) eizon space and (III) (\mathcal{L}) creation space, besides III(\mathbb{C}) control space.

This general assertion implies in particular the following specifications.

(1⁰) Some of current mathematical formulations of control processes can be and should be modified so as to reflect some characteristic features of large system.

(2^o) Various formulations which have been proved to be effective in their respective domain of validity can be and should be integrated as one mutually interconnected approach for discussing large systems.

5. Learning processes in large system should be discussed in the IInd Coordination in which the rôles of cognition and evaluation as well as direction should be carefully scrutinized.

It is also remarked that the notion of large system can be found in various fields of human activities and that it is indeed quite benefitable to our consideration of engineering large system to take into our consideration various examples from those associated with medicine, quality control, and public welfare and so on, as the author points out in his recent papers [13], [14] and [15].

Literature

- [1] Bellman, R.: Adaptive Control Processes : A Guided Tour, Princeton University Press, Princeton.
- [2] Box, G.E.P.: Evolutionary Operation : A Method for Increasing Industrial Productivity, Applied Statistics, 6(1957), 3-23.
- [3] Kitagawa, T.: Successive process of statistical controls (2), Mem. Fac. Sci., Kyushu Univ., Ser. A, 13(1959), 1-16.
- [4] Kitagawa, T.: Successive process of statistical controls (3), Mem. Fac. Sci. Kyushu Univ., Ser. A, 14(1960), 1-33.
- [5] Kitagawa, T.: Successive process of optimizing procedures, Proc. 4th Berkeley Symp. on Math. Statist. and Probability, I(1961), 407-434.
- [6] Kitagawa, T.: A Mathematical Formulation of the Evolutionary Operation Program, Mem. Fac. Sci., Kyushu Univ., Ser. A, 15(1961), 21-71.
- [7] Kitagawa, T.: Iterated control operations, Mem. Fac. Sci. Kyushu Univ., Ser. A, 19(1965), 6-36.

- [8] Kitagawa, T.: The future aspect of quality control in cybernetical era, Proceedings of the International Conference of Quality Control, 1969, Tokyo, TS. 14-01, 857-860.
- [9] Kitagawa, T.: Johogaku no ronri (The logic of information science), Kodansha, Tokyo, 1969.
- [10] Kitagawa, T.: Information science and its connection with statistics, Proc. 5th Berkeley Symp. on Math. Statist. and Probability, I(1967), 491-530.
- [11] Kitagawa, T.: Information science approaches to scientific information systems and their implications to scientific researches, Research Institut of Fundamental Information Science, Kyushu Univ., Research Report No.3 (1969), 1-41.
- [12] Kitagawa, T.: Three Coordination Systems for Information Science, Kyushu Univ., Research Report No.8 (1970) (to appear).
- [13] Kitagawa, T.: QC cycle no honshitsu to sono miraizo (The Essential Roles of Quality Control Cycles and their Future Developments), Statistical Quality Control, Vol.21, No.6 (1970), 2/798-803/7.
- [14] Kitagawa, T.: Johokagaku no Shiza (Views from Information Science), Kyoritsusha, Tokyo, 1970.
- [15] Kitagawa, T.: Hinshitsu to Joho (Quality and Information), The 11th Symposium on Quality Control, Japanese Union of Scientists and Engineers, June 20-June 28 (1970), (to appear).
- [16] Pontrajagin, L.S.: Blthanskii, Gamkrelidze, R.V., and Mischenko, E.F.: The Mathematical Theory of Optimal Control, Interscience Publishers, 1962.
- [17] Robbins, H. and Monro, S.: A stochastic approximation method, Ann. Math. Stat., 22(1951), 400-407.
- [18] Wiener, N.: Cybernetics or control and communication in the animal and the machine, John Wiley and Sons, New York, Hermannet Cie, Paris, 1st Ed. (1948), 2nd Ed. (1962).